

Determinants and Consequences of IT Capability: Review and Synthesis of the Literature

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ABSTRACT

As IT spending continuously increased over the past years, it nowadays accounts for a significant amount of total corporate spending. However, firms require the ability to transform these investments into daily operations. Research shows that the organizational IT capability is the key to leverage IT investments and achieve desired outcomes. Research on IT capability thereby evolved as a major stream in the IT business value debate and the number of research articles on IT capability increased constantly over the years. The purpose of this literature review is to provide an overview of current findings on antecedents and consequences of IT capability and to identify directions for further research. This review synthesizes a collection of 30 research articles and thereby contributes to the literature on IT capability by identifying current gaps in the literature and offering new perspectives for future research.

Keywords

Business Value of IT, IT Capability, Literature Review.

INTRODUCTION

In March 2012 Citigroup Inc., one of the top financial service provider in the U.S., announced an agreement with IBM regarding the application of IBM's super computer *Watson* to "analyze customer needs and process financial, economic and client data to advance and personalize digital banking" (Jinks 2012). Citigroup is expecting billions in new revenue from this investment. The main question for Citigroup is how to successfully apply Watson's power to achieve the expected business value.

This is just one prominent example of integrating IT into business operations to analyze customer data. Another example is the automotive industry where IT and more important human skills are used to simulate new products and even complete production processes. The list of examples throughout industries is endless. Thus, it became more important than ever to leverage IT to achieve desired outcomes. It is the bundle of technology, human skills, and the alignment of IT and business goals (Ross, Beath and Goodhue 1996) that drives the successful use of IT. Bharadwaj (2000, p. 171) defined this organizational capability as the "ability to mobilize and deploy IT-based resources in combination or copresent with other resources and capabilities".

Rooted in the literature on business value of IT (Kohli and Grover 2008), researchers identified antecedents of IT capability, like the role of IT executives (Lim, Stratopoulos and Wirjanto 2012b), and studied various outcomes. Compared to competitors, superior IT capability provides operational benefits at the process-level (Kim, Shin, Kim and Lee 2011), higher accounting-based performance at the firm-level (Bharadwaj 2000; Santhanam and Hartono 2003) as well as the ability to achieve competitive advantage (Dehning and Stratopoulos 2003).

In the past decade, research on IT capability has grown extensively and offers new insights. Therefore, the purpose of this literature review is to synthesize past research and to identify potential areas for further research.

To synthesize relevant publications on IT capability, this paper follows the guidelines suggested by Webster and Watson (2002). Covering IS research and related fields, a collection of 30 papers mainly published after the seminal paper on IT capability by Bharadwaj (2000) is reviewed. The closely related stream of research on IT spending (at the interface to accounting research) recently published a synthesis and framework of archival research (Masli, Richardson, Sanchez and Smith 2011a) as well as a meta-analysis of available studies (Lim, Dehning, Richardson and Smith 2011). Whereas Masli et al. (2011a) cover the IT business value literature in general and focus on archival research, this paper is concentrated on the

IT capability literature in specific including both, primary and secondary research. Other related streams such as IT-enabled capabilities (e.g. Joshi, Lei, Datta and Shu 2010) are therefore not covered.

This review contributes to the literature on IT business value and IT capability by synthesizing past research to provide a systematic overview of past studies and to offer perspectives for future research. From a practitioner's perspective, this paper summarizes and highlights the various benefits achievable by developing and maintaining a superior IT capability. Further, this paper includes emergent research on the determinants of IT capability.

The next section briefly describes the approach followed to systematically analyze past research on IT capability. In the subsequent sections, the concept, antecedents, and outcomes are summarized. The paper concludes with a discussion of the findings, their implications, and areas for further research.

METHODOLOGY

To identify the relevant IT capability literature, this paper follows the guidelines suggested by Webster and Watson (2002). I conducted a keyword search using online databases such as EBSCOhost, ScienceDirect, and JSTOR to cover academic journals from different disciplines (IS research, management and organizational science, accounting research, and accounting information systems). Only peer-reviewed journals are selected to guarantee a scientific quality standard. Articles are considered relevant if title or abstract contained specified keywords. Furthermore, I conducted a forward and backward search as recommended by Webster and Watson (2002) to identify additional articles overlooked in the first step.

This procedure yielded a total of 137 papers. The articles were further screened for relevance by reading title and abstract and if necessary additional parts of the text body. The articles were considered as relevant if they are related to the concept of IT capability. This approach resulted in a final sample of 30 articles related to IT capability that are presented in the following (see Figure 1 and Figure 2 for an overview by journals and years). All identified articles are marked with an asterisk (*) in the reference list.

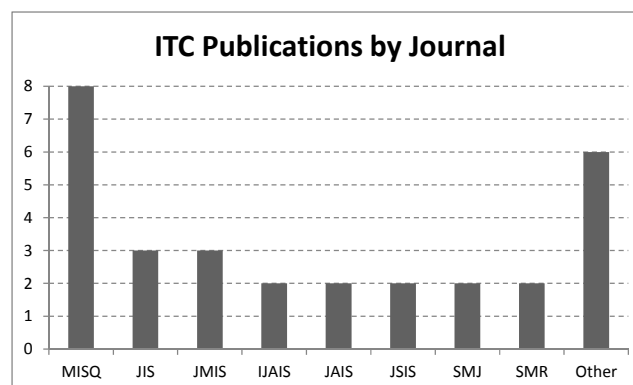


Figure 1. IT capability related Publications by Journal

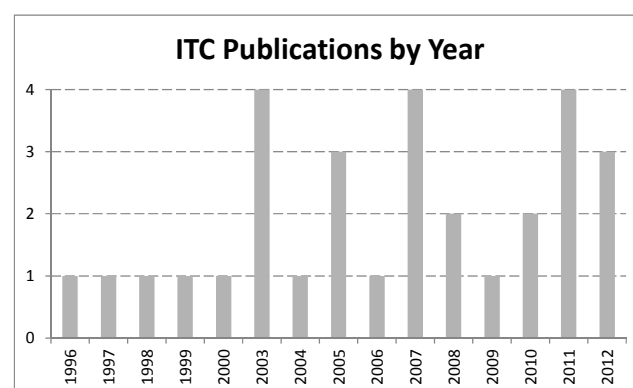


Figure 2. IT capability related Publications by Year

NATURE OF IT CAPABILITY

The IT Capability Concept

Early research studying IT capability had a rather one-dimensional perspective; either in terms of a technological capability (Sabherwal and Kirs 1994) or of a managerial capability (Sambamurthy and Zmud 1997). A first multidimensional view suggested by Ross et al. (1996) defined IT capability as “the ability to control IT-related costs, deliver systems when needed, and effect business objectives through IT implementations”. A few years later, Bharadwaj, Sambamurthy and Zmud (1999) empirically developed a six dimensional concept of IT capability (IT business partnerships, external IT linkages, business IT strategic thinking, IT business process integration, IT management, and IT infrastructure). A selection of conceptualizations of the IT capability construct is listed in Table 1. Although named different, concepts are often used interchangeably. Most studies refer to IT capability as for example Bharadwaj (2000). Others talk about IS capabilities (Feeny and Willcocks 1998; Ravichandran and Lertwongsatien 2005) or more recently about IT competence (Gordon and Tarafdar 2007; Sambamurthy, Bharadwaj and Grover 2003; Tippins and Sohi 2003). Research on IT capability is considered as an integral part of the more general research stream on business value of IT (Kohli and Grover 2008).

The most widely cited definition of IT capability – the “ability to mobilize and deploy IT-based resources in combination or copresent with other resources and capabilities” – originates from Bharadwaj (2000, p. 171). A firm’s IT capability is seen as the basis to achieve advantages from IT investments (Duliba, Kauffman and Lucas Jr 2001) and depends on the ability of firms to transform IT investments into assets that may form a unique IT capability over time (Ravichandran and Lertwongsatien 2002). IT capability is considered as the “ability to sustain IT innovation and respond to changing market conditions through focused IT applications” (Bharadwaj et al. 1999, p. 381). In summary, prior research emphasizes the multidimensionality of IT capability and the required complementarity between IT and organizational assets and capabilities. A recent study by Lim, Stratopoulos and Wirjanto (2012a) further contributes to these foundations by showing the path-dependence in achieving IT capability leadership.

Study	Technological dimension	Human dimension	Organizational dimension
(Ross et al. 1996)	- Technology base	- Competent IT human resource	- IT & business management partnering relationship
(Bharadwaj et al. 1999)	- IT infrastructure - External IT linkages	- Business IT strategic thinking - IT management	- IT business partnerships - IT business process integration
(Bharadwaj 2000)	- IT infrastructure	- Human IT resources	- IT-enabled resources
(Melville, Kraemer and Gurbaxani 2004)	- Technological IT resource (infrastructure and applications)	- Human IT resource	- Complementary organizational resources

Table 1. IT Capability Dimensions and underlying Resources

Theoretical Background

From a theoretical point of view, most of the studies build upon the resource based view (RBV) of the firm (cf. Barney 1991; Grant 1991; Wernerfelt 1984). The basic assumption of the RBV requires specific assets and capabilities to be valuable, rare, difficult to imitate, and non-substitutable by other resources to provide strategic benefits. It is argued that IT resources (cf. Table 1) satisfy these conditions due to their firm-specific and complex nature. IS research identified a bundle of IT related resources that satisfy these conditions (see for example Mata, Fuerst and Barney 1995; Wade and Hulland 2004). The combination of these resources creates the basis of organizational capabilities or in the specific context a firm-level IT capability.

ANTECEDENTS OF IT CAPABILITY

Research covering antecedents of IT capability is rather rare. Lim et al. (2012b) identified this gap and investigated the effects of senior IT executives’ structural power on firms IT capability. The influence and importance of IT managers increased with the use of IT in business operations. Over time the focus shifted from daily operations to strategic topics and IT executives became part of executive boards in various firms. Lim et al. (2012b) find evidence for IT executives’ contribution to developing superior organizational IT capability. Bhatt and Grover (2005) raise another important factor of developing IT capability: the intensity of organizational learning. Research shows that the development of IT capability takes

time and is even path-dependent (Bharadwaj 2000; Lim et al. 2012a). Findings by Bhatt and Grover (2005) strongly support the influence of organizational learning on IT capability development.

IT CAPABILITY OUTCOMES

Performance

Conceptual Studies

Although the majority of studies are of empirical nature, two articles scrutinize the underlying mechanisms between IT capability and firm performance. Sambamurthy et al. (2003) develop and propose a theoretical model linking information technology and financial performance. They argue that IT competence, the ability to leverage IT resources and capabilities, generates digital options and agility. Firms require and depend upon entrepreneurial alertness and actions to develop, activate, and exploit such capabilities to launch frequent and varied competitive actions and to gain financial benefits in the end. In a similar vein, Melville et al. (2004) suggest an integrative model emphasizing the complementarity of IT and organizational resources, the importance of business processes and process performance, as well as the consideration of firm, industry, and country characteristics.

Longitudinal Studies

Despite on exception (cf. Aral and Weill 2007), longitudinal studies are based on archival data like financial databases or retrieved from secondary sources such as publicly available rankings. Performance is measured from two distinct perspectives, either accounting-based or market-based.

Bharadwaj (2000) was among the first to study the performance effects of an organizational IT capability. Selecting a small sample of highly ranked IT capability firms and comparable control firms, she compared several accounting-based cost and performance measures. The results show a general tendency that firms with a continuously high – or in her terms superior – IT capability outperform direct competitors. A few years later, Santhanam and Hartono (2003) extended her study with similar outcomes. They compare superior IT capability firms with their industry average, thereby including several lag effects.

To examine performance effects in more detail, Stoel and Muhanna (2009) split the highly aggregated firm-level measure of IT capability into internal and external IT capability and consider environmental factors (i.e. dynamism, munificence, and complexity). Chen, Lim and Stratopoulos (2011) follow a different approach and distinguish systematic IT capability, occasional IT capability, and non-IT capability competitors. Examining firms' ability to recover from losses during the 2000 economic downturn, they provide evidence that systematic IT capability firms have higher chances to adapt to a radical changing market environment and thereby generate higher abnormal earnings than competitors. Looking into the future, Muhanna and Stoel (2010) find "that IT capability is a significant predictor of positive future earnings, while IT spending is not". This result highlights the superior role of IT capability and should be a warning the pure spending evaporates if not leveraged appropriately.

The previously mentioned papers all make use of the annual InformationWeek ranking as a proxy for IT capability. Not surprising, alternative datasets lead to similar outcomes. Masli, Richardson, Sanchez and Smith (2011b) measure IT capability based on the CIO Magazine's "CIO 100 Award". Their results show that higher accounting-based performance in award winning years is only visible for years before 1999. After this date, benefits are only visible for firms that almost continuously received awards. This result is comparable to what prior studies refer to as superior IT capability (Bharadwaj 2000; Santhanam and Hartono 2003). Similar to Chen et al. (2011), a study by Aral and Weill (2007) covers the time frame around the millennium. In contrast to previous studies, they estimate IT capability as a linear combination of six variables based on survey data. Estimating the effects of IT capability and different areas of IT-spending separately and in combination, the authors find (similar to Muhanna and Stoel 2010) that IT capability leverages the intended performance effect of respective IT-spending accompanied by side effects on other performance dimensions.

Taking a market-based performance perspective, several studies estimate the effect of IT capability on Tobin's Q (Aral and Weill 2007; Lim et al. 2012b; Masli et al. 2011b). Although the time frames, data sources, and operationalizations of IT capability differ, the positive and significant effects are stable throughout the studies. However, especially in current increasingly competitive and more volatile times a continuous i.e. superior IT capability (in opposite to occasional strength) is required to maintain above average market valuation (Lim et al. 2012b; Masli et al. 2011b).

Two recent articles examine the relationship between IT capability and market valuation (Muhanna and Stoel 2010; Wang and Alam 2007). Both studies build upon the residual income valuation (RIV) framework developed by Ohlson (1995) and are based on a broad time frame (1991-2006) of IW data. The earlier paper identifies a positive and significant relationship between IT capability and stock prices. Wang and Alam (2007, p. 37) conclude “that IT capability enhances firm value [...] and the additional value is recognized by the stock market”. The paper by Muhanna and Stoel (2010) further confirms these findings and moreover highlights that only IT capability but not IT spending is significantly reflected in stock prices. Despite the positive effects on market valuation, IT capability increases future earnings uncertainty as well as forecast error and dispersion and thereby decreases analyst forecast accuracy (Wang and Alam 2007). This increased uncertainty reflects the inherent risk of IT investments that has been shown in the past (e.g. Dewan, Shi and Gurbaxani 2007).

Cross-sectional Studies

Since datasets for archival and econometric studies are rare they depend on highly aggregated publicly available firm-level measures of IT capability. Cross-sectional studies have the advantage to collect more detailed measures and facilitate the operationalization of complementary and mediating factors.

As one of the first empirical studies on IT capability, Powell and Dent-Micallef (1997) hypothesize that IT resources only in combination with human and business resources explain differences in firm performance. Studying the U.S. retail industry, they find empirical evidence and conclude that “technology alone is not enough” – a recurring theme in IT value research. For example, Ravichandran and Lertwongsatien (2005) examine the support of IS capabilities (IS planning, IS development, IS support, and IS operations) for core competences to achieve higher performance outcomes with similar results. Tippins and Sohi (2003) compare a direct effect model of IT competency on firm performance with a model considering organizational learning as a mediating factor. All measures are in favor of the mediated model and contribute to uncover the black box between IT and performance.

Another benefit of cross-sectional studies is feasible research at the process-level. Studying the customer service process at insurance companies, Ray, Muhanna and Barney (2005) do not find any direct effect of different IT capability dimensions or flexible IT infrastructure on performance. However, they find a strong direct effect of shared knowledge as well as week interaction effects between knowledge sharing and IT capability dimensions. Other studies examine the mediating role of supply chain process integration (Rai, Patnayakuni and Seth 2006) and process-oriented dynamic capabilities (Kim et al. 2011). In both cases, the authors find strong support for the beneficial role of IT resources and IT capability at the process-level and subsequent performance outcomes.

Empirical studies in this field covering other countries than the U.S. are relatively rare. A recent study by (Zhang, Sarker and Sarker 2008) on SMEs in China analyzes the direct association between the six IT capability dimensions developed by (Bharadwaj et al. 1999) and performance. Disregarding potential indirect effects, the authors only find significant effects of IT business partnerships and IT management.

Whereas the previous articles studied IT capability in general, Mithas, Ramasubbu and Sambamurthy (2011) focus on information management capability (IMC) in specific. They show that IMC plays an important role in developing organizational management capabilities (customer, process, and performance management capability) that in turn are beneficial for various performance measures. This study highlights the vital role of IT on the one side but as well on the other side the complex dependencies to exploit it appropriately.

Competitive Advantage

Based on the conceptual work by Mata et al. (1995) and measures derived from ComputerWorld’s Premier 100, Dehning and Stratopoulos (2003) investigate the role of managerial and technical IT skills as well as IT infrastructure in achieving sustainable competitive advantage. Comparable to other studies only managerial IT skills turned out to have a significant influence. Some companies in their sample were able to sustain their competitive advantage up to ten years upon implementation.

Collecting data from manufacturing firms, Bhatt and Grover (2005) study different types of IT capabilities and their role in generating competitive advantage. Taking a traditional resource-based perspective, the quality of IT infrastructure did not have a significant influence. However, more complex and hardly imitable resources like the quality of IT business expertise and relationship infrastructure contribute to competitive advantage. Comparable to other studies on performance, Rai and Tang (2010) investigate complementarities and the effect of structural IT capabilities (IT integration and IT reconfiguration) on establishing competitive process capabilities (process alignment and flexibility) to achieve competitive performance

(defined as “a firm’s attainment of its objectives in relation to its external environment”, p. 517). They find support for the hypothesized complementarity and effect of IT capabilities on competitive process capabilities.

Innovation Success

Gordon and Tarafdar (2007) identify and address a missing link between IT capabilities (they refer to it as IT competences relevant in the innovation process) and innovation success. These IT competences encompass (1) information and knowledge management, (2) project management, (3) collaboration and communication, and (4) business involvement. Three exploratory case studies in different industries were conducted by the authors. Their results demonstrate that all four IT competences are relevant to three stages (initiation, development and implementation) of the innovation process. Another case study from Tarafdar and Gordon (2007) shows the benefits of six IS competencies on different phases of two process innovations in a hospital. Using survey data, Aral and Weill (2007) analyze the impact of IT spending and IT capability on innovation in terms of sales from new and modified products. They find that a strong IT capability in combination with IT investments enables greater revenues from new products but has a non-significant effect on revenues from modified products.

Other

Analyzing the inter-firm relationships of a major logistics supplier, Rai, Pavlou, Im and Du (2012) examine the creation of relational value based on the interlocking of logistic processes. To assess the degree of process interlocking they define four different IT capability profiles starting from basic automation up to complete logistics synchronization. Findings show that higher sophisticated inter-firm IT capability profiles lead to an increased relational value in terms of share of wallet and loyalty. Additional inter-firm communication on business and IT development contributes as well to relational value. However, interaction effects turned out to be significant only for business related communications.

DISCUSSION

Research on IT capability constantly increased over the past decade. The purpose of this literature review is to synthesize the current state of the literature. Thereby, three main contextual clusters emerged. The vast majority of articles investigate different performance outcomes. Longitudinal studies focus either on accounting-based or market-based performance measures whereas cross-sectional research mainly investigates resource complementarities or mediating factors. The other two equally frequent examined topics are effects on firms’ competitive advantage and innovation success. Additional outcomes beyond these main themes are basically not covered. With regard to antecedents of IT capability, research is as well rather sparse and insufficiently studied.

These findings highlight several research gaps and thereby demand for further research. Considering antecedents of IT capability, research is required to identify additional driving forces in developing and maintaining IT capability at different levels of analysis including firm external forces. The IT spending literature for example indicates that environmental, organizational, and technological factors affect budget decisions (Kobelsky, Richardson, Smith and Zmud 2008). This might be a good point to start. However, empirical research on antecedents of IT capability will be valuable to decision makers and IT executives and is required to better understand the drivers and inhibitors.

As Kohli and Grover (2008, p. 27) state, “the subjectivity of primary data, inaccessibility of reliable secondary data, unavailability of appropriate proxies, and use of cross sectional designs inhibit the study of IT value.” This notion underlines the importance to create alternative and more detailed datasets to better capture the IT capability concept and enable more comprehensive longitudinal analyses. This allows as well to investigate mediating effects over time and to analyze mechanisms at the process level.

With regard to different outcome variables, IT capability research is mainly limited to performance effects. Particularly innovation success is hardly covered in the literature; quantitative studies both cross-sectional and longitudinal are missing. For example, patent data provides long-term information on R&D activities and has been widely used in IS research (Joshi et al. 2010; Kleis, Chwelos, Ramirez and Cockburn 2012). Taking a capital market perspective, implications of IT capability on risk and return might influence equity owners and potential investors. For example, findings for IT intensity show an impact on risk (Dewan et al. 2007), bond ratings and cost of debt (cf. Kim and Mithas 2011).

This review contributes to the growing literature on business value of IT by providing an overview of the current state of IT capability research. On the one hand the various effects so far identified in the literature are summarized. On the other hand several gaps in the literature are uncovered that demand for research in the future.

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